

NASA EDUCATION FORUM AT SAO ON THE STRUCTURE AND EVOLUTION OF THE
UNIVERSE

NCC5-261

ANNUAL PROGRESS REPORT NO. 4

For the Period 15 January 2001 through 14 January 2002

Principal Investigator

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SMITHSONIAN INSTITUTION

ASTROPHYSICAL OBSERVATORY

CAMBRIDGE, MASSACHUSETTS 02138

The Smithsonian Astrophysical Observatory

is a member of the

Harvard-Smithsonian Center for Astrophysics

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Annual Report
Period of Performance: 1/15/01 - 1/14/02
The NASA Education Forum at SAO
on the Structure and Evolution of the Universe

Grant Number NCC5-261
November 14, 2001

A. Accomplishments for the previous year.

Overview. During the past year the SEU Forum has made significant progress on a number of fronts:

- The Forum has brought several large education projects close to completion.
- We have greatly expanded our relationship with the SEU missions and programs; and
- We have started a significant program to better involve space scientists in education and outreach activities.

Among our accomplishments for the past year:

Completed Planning and Design for *Cosmic Questions*, a National Traveling Exhibition on SEU Themes.

The Forum and its key partners (ASTC, Jeff Kennedy Associates, and the Boston Museum of Science) completed planning and design documents for the *Cosmic Questions* exhibition, which will open September 19, 2002 at the Boston Museum of Science and then travel nationally. About one dozen activities from the exhibition were prototyped and evaluated with visitors at the Boston Museum of Science by the PERG group from Lesley College. Based on the evaluation, and on further discussions with the space science community, final modifications were made to the exhibition design and bid documents. The fabricator will be selected by competitive bid in January 2002. The Association of Science-Technology Centers (ASTC) promoted the exhibition at its annual meeting in Phoenix. Interest in the exhibition is high; a tour list will be drawn up by ASTC in early 2002.

Collaboration with other museums and organizations. As a result of the project, the Forum has expanded its collaborations with the SEU missions, with the museum community, and with diverse audiences. To cite a few examples: The Forum has been working with the Marshall SFC, which is providing a model of Chandra and one of the Chandra back-up mirrors for the exhibition. The

Forum also provided the National Air and Space Museum with educational materials and video interviews with scientists, shot for *Cosmic Questions*, for use in NASM's new *Explore the Universe* exhibition. We anticipate that five or six of the components of *Cosmic Questions* will be replicable for permanent use in museums nationally.

Launched the Informal Science Education Resource Directory.

In collaboration with other members of the support network, the SEU Forum launched a significant new Web resource, "Space Science Access: Bringing the Universe to Museums and Planetariums." The site resides jointly on servers at SERCH and at the Center for Astrophysics, with the entrance at: <http://serch.cofc.edu/watering/resources.htm>.

The site supports the efforts of planetariums, science centers, and museums through three main resource sections designed to evolve and grow with NASA's education and outreach programs. "NASA Space Science Resources" serves as a portal to access space science images, data, education programs and human resources of particular interest to planetariums and science centers. "Project Sharing" supports communication among groups who are developing informal astronomy education projects, by providing a community bulletin board. "Best Practices" posts articles and resources aimed at improving the quality of future informal science education programs and projects.

Plans for maintaining and disseminating. The site is periodically updated by members of the Informal Science Working Group. Future steps include wider advertising of the site; links from related sites such as ASTC's and planetarium societies' sites; and active involvement of space scientists and educators in the growth of the site.

Coordinating with the SEU and Origins missions.

The Forum has worked closely with the SEU missions and programs this year, and the results have paid off.

Greatly expanded communication. The Forum hosted several meetings and dinners with mission E/PO leads, at timely events such as the AAS and NSTA meetings; as a result, the group has acquired an esprit de corps. The Forum hosts monthly teleconferences with the missions, during which information and plans are shared and discussed. The Forum also participates in each Origins Forum teleconference as well, and we report on these teleconferences to our SEU missions. In January 2002, E/PO leads from both SEU and Origins missions will have a joint dinner at the AAS meeting.

Collaborated with the Sonoma State space science group. The Forum has been working with the Sonoma State space science group to produce a folder with information about the missions and simple classroom activities. We are also

working with the SEU missions towards production of a comprehensive kit on the SEU theme (see section B).

Product review. The product review process has stimulated discussions among the missions about how best to improve the quality of SEU products. The process has also made mission scientists more aware of the support network's education efforts.

Outcome of Minority Conference. The Forum participated in the Western Kentucky University conference that brought together minority professional societies with the OSS support network. As a result of the conference, the Forum brokered a partnership between one of our missions and NOBCCHE on an upcoming project.

Student-Scientist Partnerships: "From the Ground Up!" Curriculum. This has been an important year in advancing our aim of getting SEU space science into the classroom, using an innovative curriculum in which students carry out investigations using automated, online telescopes.

First light for Mauna Kea education telescope. The SEU Forum shipped a MicroObservatory telescope to Mauna Kea, where it was installed on the roof of the Sub-Millimeter Array building by onsite Smithsonian staff. We believe this is the only telescope on Mauna Kea devoted solely to education. Within a week of its installation, the telescope was used by teachers and students in several dozen states. A program is underway to involve Hawaiian schools in "hosting" the telescope and contributing to the curricular activities.

Teachers at summer workshop evaluate materials. Several innovative activities for use with the telescopes were classroom-tested by our core teachers; their results were reported at a summer institute at the Center for Astrophysics. For example, teachers reported on projects in which eight-graders used the telescopes to image galaxies and to discover Hubble's law for the universe's expansion — combining NASA data on recession speeds with their own data on distances to the galaxies. The activities are being modified based on the classroom evaluations. They form the basis for understanding many of NASA's science themes and missions.

Light, color, and Chandra activities. What can Chandra and other SEU missions reveal that ordinary visible light images cannot? The Forum has been developing activities in which students' compare telescope images they have taken themselves, with Chandra's view of the same region. The result is a compelling and dramatic investigation in which students "discover" such cosmic features as black holes and giant gas clouds. Based on teachers' recommendations, we are developing materials to address the important roadblocks to student understanding, such as the meaning of false-color images.

AAS meeting presentation. Results of the Forum's work with online telescopes were presented at the "Innovations in Teaching Astronomy" session at the annual meeting of the AAS in January 2001.

Promoted Scientist-Educator Partnerships

"Passport to Knowledge" Series. The SAO's Science Media Group produced animations, and the Forum provided logistical support, for two highly successful shows in this popular series, "Live From a Black Hole" and "Live From the Edge of Space," which aired in March, 2001. Several SEU missions were able to participate, and the scientists involved were pleased to be part of the ongoing education initiative.

NSTA "Expanding Universe" Modules. Working with scientists at the Center for Astrophysics, the Forum developed an innovative teaching module on spectroscopy and the expanding universe, which incorporates scientists' data on the recession of galaxies. A version of the module was presented at the National Science Teachers' Association meeting in April 2001, and an interactive web version was posted (<http://cfa-www.harvard.edu/seuforum/galSpeed>).

"What's Up in the Universe?" Series. The SEU Forum supported and collaborated on a portion of this six-part series (still in production), to be broadcast through Oregon public television and shown in classrooms nationally. A sequence from the film, including animation of the structure of the galaxy, will be incorporated in an interactive "fly-through" of the universe in the traveling exhibition, "Cosmic Questions."

B. Summary of goals, plans, and proposed activities for the year 1/15/02 - 1/14/03.

This will be a very exciting year in which several major projects will come to fruition, and in which new, ambitious goals will be addressed. We are in the process of hiring two additional, full-time senior staff for the Forum, who will help realize these goals. We plan to:

- Begin a space science initiative with the Boston Public School system which coordinates with, and builds on, similar programs in Chicago and Los Angeles.
- Significantly increase scientist participation in NASA OSS education programs throughout the Northeast.
- Collaborate with our SEU missions and programs to create a seamlessly integrated SEU "kit" for students, teachers, and the public.

New Projects. The Forum will give high priority to new projects that support the above new goals.

Boston and Regional School Initiative. Our goal is to enlist NASA's space science resources—including materials, curriculum, and people—to enhance pre-college science education. The Forum plans to work with Marilyn Decker, who is Boston's new and enthusiastic director for science, curriculum, and instruction in the public schools. Initially, we will focus on opportunities for professional development for teachers—an area of increasing importance and one in which space scientists in the region can play an active role.

The Forum will build on existing ties with science coordinators and superintendents in Cambridge and twelve other school districts in the Commonwealth. We will pay special attention to identifying significant gaps in available resources.

The Northeast Broker (the Boston Museum of Science), which is host to more than 200,000 students and teachers from the region, will play an important role in this collaboration. Forum staff have already started preliminary discussions with the Broker about avenues for synergy.

Increase scientists' participation in NASA OSS education programs. One of the Forum's highest priorities this year is to significantly increase both the level and visibility of scientists' participation in education / outreach programs. We will devote a full-time senior staff person to this effort.

A cornerstone of our effort is to build a coalition among already-interested scientists at the Center for Astrophysics, MIT, Tufts, and Boston University, expanding to space scientists at Brown University, Maine and New Hampshire. Irene Porro at MIT and Ken Brecher at Boston University have provisionally agreed to serve as local contacts for this effort. We have also been working with the cosmology group at Tufts university. We would like to enlist Roscoe Giles at BU and several scientists at the CfA as core collaborators. Again, the Northeast Broker will be a key player in this effort.

We want to achieve three goals here: 1) Ensure that the space scientists are aware of the opportunities for participation, by means of periodic seminars and updates to the space science community. 2) Provide a small number of high-impact, high-visibility projects highlighting space scientists. (The Forum's Web site is being redesigned to feature vignettes of scientists, e.g.) 3) Ensure that the best NASA education products are made available to the space science community for use in their own classrooms. (Much of what the support network does is usable by the space science community as well as the education community.)

The Forum will work closely with the SAO's new public affairs director, David Aguilar, whose office will help coordinate and publicize some of the regional outreach efforts.

SEU "Kit": Joint Project with Missions and Programs. The Forum has been working with the Sonoma State group and the SEU missions to develop a kit of educational materials and resources that motivate, explain, and publicize the science questions in the SEU (and Origins) theme. The theme of the kit has been agreed on: "Seeing the Universe with New Eyes."

The challenge for this group is to move the kit beyond being an odd assortment of information about the missions, to being an integrated package that shows the logic of the SEU theme questions, but also provides some background for the key concepts that we know are stumbling blocks with the public and with educators. (For example, "Looking out in space is looking back in time," and "False color represents wavelengths of light we can't see.") We will devote significant resources to collaborating with the missions to bring this to fruition.

Completion of Major Ongoing Programs

Premiering the *Cosmic Questions* Exhibition. Completion of the Cosmic Questions exhibition is a major effort for the coming year. In addition to the exhibition itself, significant work will be done in three areas:

Coordinating educational materials. The demonstrations, programs, and educational materials being produced as part of the project provide an excellent opportunity to integrate many of the resources that already exist in our theme. The Forum will work with the SEU missions and space science community to bring order to these materials. (A kick-off teleconference was recently held with the SEU missions and the Museum of Science, to promote involvement of the missions in the production of educational programs for the exhibit.)

Scientist involvement. The exhibition is an important vehicle for involving space scientists in their local museums for lectures, demonstrations, etc. We will work with ASTC and other organizations to coordinate this involvement. (The Forum has already recruited Boston-area scientists to provide professional development for staff at the Museum of Science, in preparation for the exhibit opening.)

Disseminate components. Several of the exhibition's components can be replicated for use at any science museum. Examples include interactive fly-throughs of space and time; a simulated journey to a black hole; and an information / update station about NASA space science activities. We will follow-up on the interest in the museum community generated by the exhibition (as evidenced at the last ASTC meeting) to help disseminate components and programs to museums not on the tour.

Online Telescopes and Space Science Curriculum. This curriculum will be completed during the coming year. We plan to make the curriculum available on the Web and in print, including a version which uses archived images and

does not require access to the telescopes. (The archival version was evaluated by teachers at a summer workshop.) Among the plans for the curriculum:

AAS press conference. The SAO's public affairs department has planned to publicize the project, and NASA's involvement, at the AAS meeting in January 2002.

Forum - TERC - MIT collaboration. The Forum has agreed to partner with TERC, and with space scientists and educators from MIT, in a summer program for teachers and students that incorporates the online telescopes and related space science activities. The program will be hosted at the Center for Astrophysics, and led by scientists from MIT and educators from TERC.

Midwest Broker collaboration: Teachers' Institute. With the Midwest Broker, the Forum is making available online telescopes and space science activities for a summer institute in Chicago for teachers.

Work with W. Virginia Broker. The SAO has a strong interest in showcasing a suite of astronomy-related educational materials in the state of West Virginia. The Forum would like to collaborate with the new West Virginia broker to provide access to the online telescopes and materials, and to develop a model for how existing NASA materials can be coordinated with telescope use. The goal would be to implement the next generation of the "classroom of the future."

C. Interactions with the Space Science Community

We now work with space scientists routinely, in virtually every aspect of Forum operations, and we actively collaborate with scientists and institutions beyond the CfA. In addition to the interactions cited above were the following:

American Astronomical Society Meeting. The Forum presented a session on space science education using online telescopes, and participated in a discussion with scientists and educators about new technologies that will increase opportunities for independent student projects.

Presentation to Marshall Space Flight / Chandra meeting. The Forum gave a presentation to officials from the Marshall Space Flight Center about the *Cosmic Questions* exhibition. MSFC is a collaborator in the exhibition, as described above.

Consultations on E/PO proposals. Forum staff have worked with space scientists in the Boston area in helping to define productive areas for education and outreach. A number of these proposals cut across theme boundaries and should interest several of the Forums. We plan to pursue this at the upcoming Education Council meeting.

Product review. The Forum organized and worked with scientists for the product review process. While the scientists reported that their review required much more time than they had expected, they were uniformly pleased to be part of the process.

Projects with scientists. Scientists seek out the Forum when they have good ideas for projects. For example, we are exploring with members of the Supernova Team a project in which students search for supernovae using partially reduced current scientific data. The project would coordinate with a number of other SEU theme activities.

D. Coordinating with the Forums and Brokers.

As always, it has been a delight to work with the Forums and Brokers this past year. A few examples of collaboration:

Origins Forum. Forum staff participate in each Origins Forum teleconference. We have also been consulting with John Stoke and look forward to collaborating with his group at STScI in the coming year.

Forums. Forum staff worked with the other Forums and brokers (especially SERCH) on the successful completion of the informal science education Web site.

DePaul Broker. The Forum worked to provide a keynote speaker for OSS Education conference, and has been working with the DePaul broker regularly to coordinate contacts with the planetarium community.

Ohio Broker. Forum staff have consulted with the Ohio broker on an IDEAS grant for minority universities. The Forum has also written several short articles for the external newsletter for the space science community.

SERCH Visit. SERCH and Forum staff spent a day in meetings at the Center for Astrophysics, discussing projects for collaborations. Among those explored: a project in teacher professional development that would involve the SAO's Science Media Group and SERCH's involvement with AT&T's distance learning project.

Summary. This has been a fruitful year for the Forum. We are looking forward to a very busy and very productive year that will see the completion of several high-visibility, high-impact projects.

E. Key Personnel.

In addition to staff mentioned in previous reports, we have posted positions for, and are negotiating to hire, two new full-time senior staff. Along

with the Forum director and other Forum staff, they will be responsible for coordinating projects involving the space science community, the Boston public schools, and the SEU missions. We look forward to the expertise and enthusiasm they will bring to the support network.

F. Budget Narrative.

We request \$1,600,000 for the fifth year of the project beginning on 15 January 2002. Our proposal budget in NASA format follows.

PROPOSAL BUDGET SUMMARY

FROM: January 15, 2002 - January 14, 2003 (Year 5)

TITLE: NASA Education Forum at SAO on the Structure and Evolution of the Universe

P.I./INSTITUTION: Roy R. Gould/Smithsonian Astrophysical Observatory

NASA USE ONLY

	A	B	C
1. Direct Labor (salaries, wages, and fringe benefits)	\$575,207		
2. Other Direct Costs:			
a. Subcontracts	516,900		
b. Consultants	14,000		
c. Equipment	0		
d. Supplies	32,250		
e. Travel	30,344		
f. Other	177,551		
3. Indirect Costs	253,748		
4. Other Applicable Costs	0		
5. Subtotal--Estimated Costs	1,600,000		
6. Less Proposed Cost Sharing	0		
7. Carryover Funds (if any)	0		
a. Anticipated amount	0		
b. Amount used to reduce budget	0		
8. Total Estimated Costs	\$1,600,000		XXXXXX
APPROVED BUDGET	XXXXXXXXXX	XXXXXXXXXX	

